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**Theme 6: Environment (including climate change)**

# D3.2 – Model of the local decision making process

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## 1. Introduction

The ultimate objective of TESS is to design a transactional environmental decision support system, linking central policy planning to local livelihoods. The project aims to assist policy makers to integrate knowledge from the EU, national, regional and local level into the decision making process. There are several aspects of decision making that need to be considered in the design of a support system: information needs and flow; the processes that are to be influenced by the decision and the decision making process itself (Wierzbicki, A. et al., 2000).

A survey of local governments and other stakeholders across the partner countries characterised the use of information on biodiversity and ecosystem services in the environmental decision making process (see D3.3 synthesis report). A variety of information flows, analysis approaches and decision processes used for environmental assessment and sustainability assessment for biodiversity were identified by discussions with government departments (WP2) and local case-study sites (WP3) across a limited range of countries, in which partners are based and in which governance approaches are likely to differ. Combining their results revealed complex interactions and patterns of information flows between local, regional and national decision makers.

Conceptual models serve as a key planning and evaluation tools in conservation projects and are useful tools for expressing interactions in complex systems (Margoluis, R. et al., 2009). They are used in information systems development to represent static or dynamic phenomena and to articulate user requirements (Wand, Y. and Weber, R., 2002). In this case, conceptual models are used to illustrate the flow of information between local and central governments and local stakeholders. This information will be used to determine the scope for information transactions and will assist the design process for the decision support system (D6.3).

# 1. Information flow models

## 1.1. Data exchange conceptual model

The data exchange conceptual model (figure 1) aims to illustrate the information flows between local stakeholders and local, regional and central governments.

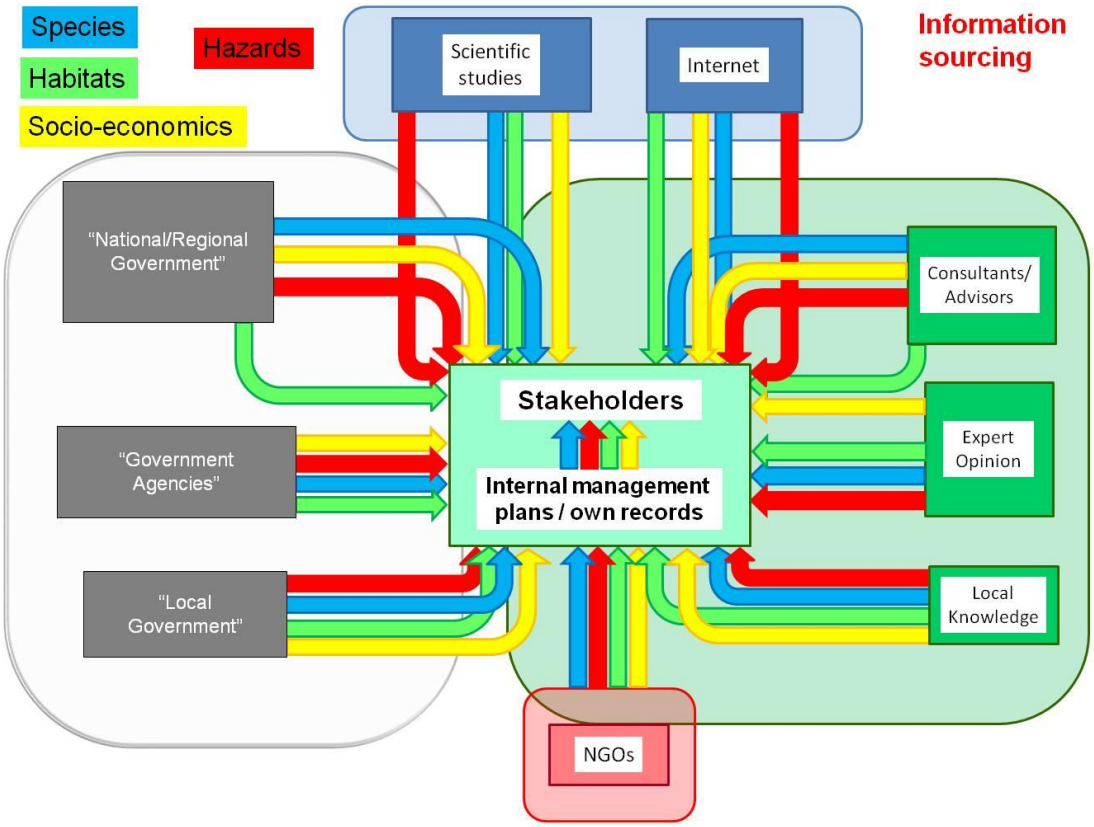


Figure 1: Data exchange conceptual model

The general model (figure 1) highlights the complexity of the patterns of information flow and illustrates the reciprocal nature of data exchange between the different groups of decision makers. This model also highlights the need for further investigation of the complexities of information exchange between different stakeholder groups and tiers of local government.

## 1.2. Methodology

Information flow models (figures 4-11) were created to illustrate the complexity of information exchange and participation in different aspects of environmental decision-making for each stakeholder category and tier of local government. The models represent the number and volume of information exchanges within each stakeholder category and tier of local government. The input data were extracted from the TESS WP3 survey forms for the individual stakeholders and tiers of local government identified in this pilot work package.

The survey involved interview of between 6-8 individual stakeholders and representatives of two tiers of local government within a case study area in 8 EU countries (2 case study areas for Turkey). Individual stakeholders represented six sectors of local environmental decision makers and consisted of a mixture of public, private and NGO companies and individuals. Not all stakeholder categories were represented in each case study area.

Part of the survey involved an open question asking respondents to list the key environmental issues affecting them and to state the information sources that they typically used to help them to address each of these issues. To summarise these results, each of the information sources identified by the interviewees was assigned to a series of category codes (Table 1). Each information source could be assigned to more than one category where relevant. The number of issues informed by each source was then calculated.

Table 1: Information source categories and codes

| Information Source Code | Information Source Category |
|---|---|
| a | Local knowledge |
| b | Scientific studies / research |
| c | Internet search |
| d | Private consultants / external advisors |
| e | NGOs |
| f | Government agencies |
| g | Local government / data provision |
| h | National or regional government / legislation |
| i | Internal management plans/ own records |

Further categorisation into types of decisions was necessary to create the information flow model. To do this, the environmental issues were categorized using a "decision code", according to the types of decision variables relevant to environmental management (Table 2).

Table 2. Decision variable code for stakeholder categories to aid in the categorisation of survey responses for the development of a conceptual model of information flows.

| Decision Code | Decision variable | Examples of environmental issues identified |
|---|---|---|
| 1 | Habitat management | Measuring habitat quality, habitat restoration, soil qualities, public access |
| 2 | Species management | Wildlife regulations, game management, control of wild species |
| 3 | Socio-economic issues | Subsidy opportunities and constraints, diversification income, tourism and recreation |
| 4 | Hazard management | Flood prediction, waste management, noise pollution, weather damage |

It was then possible to determine the strength of and type of flow of information for each decision variable (i.e. what information sources were being used for each decision variable). To indicate the strength of the relationship between the decision variable and the information source, the number of issues that used each information source (per decision variable) was calculated and the thickness of the arrow weighted accordingly as per Table 3. A thicker arrow indicates a higher number of issues used that information source. The same method was used for all diagrams. Different types of decisions were illustrated with different colours of arrows, species decisions were blue arrows, habitat decisions were green, socio-economic ones yellow and hazards were red.

Table 3. How the number of decisions that each information source were referred to was translated into the width of block arrows on the information flow diagrams.

| Decisions | Multiplier | Arrow width (cm) |
|---|---|---|
| 1 | 0.1 | 0.1 |
| 2 | 0.125 | 0.25 |
| 3 | 0.166667 | 0.5 |
| 4 | 0.2 | 0.8 |
| 5 | 0.25 | 1.25 |
| 6 | 0.3 | 1.8 |
| 7+ | 0.3 | 2.1 (etc.) |

## 2. Results and discussion

### 2.1. Environmental decisions

There was considerable variability in the types of decisions made across the different stakeholder groups and tiers of local government (figure 2). This variability can partly be explained by the nature of activities each stakeholder group was involved in. For example, the “hunting and recreational animals” category identified the majority of issues related to species management, whereas the recreational access category identified the majority of issues related to socio-economic decisions.

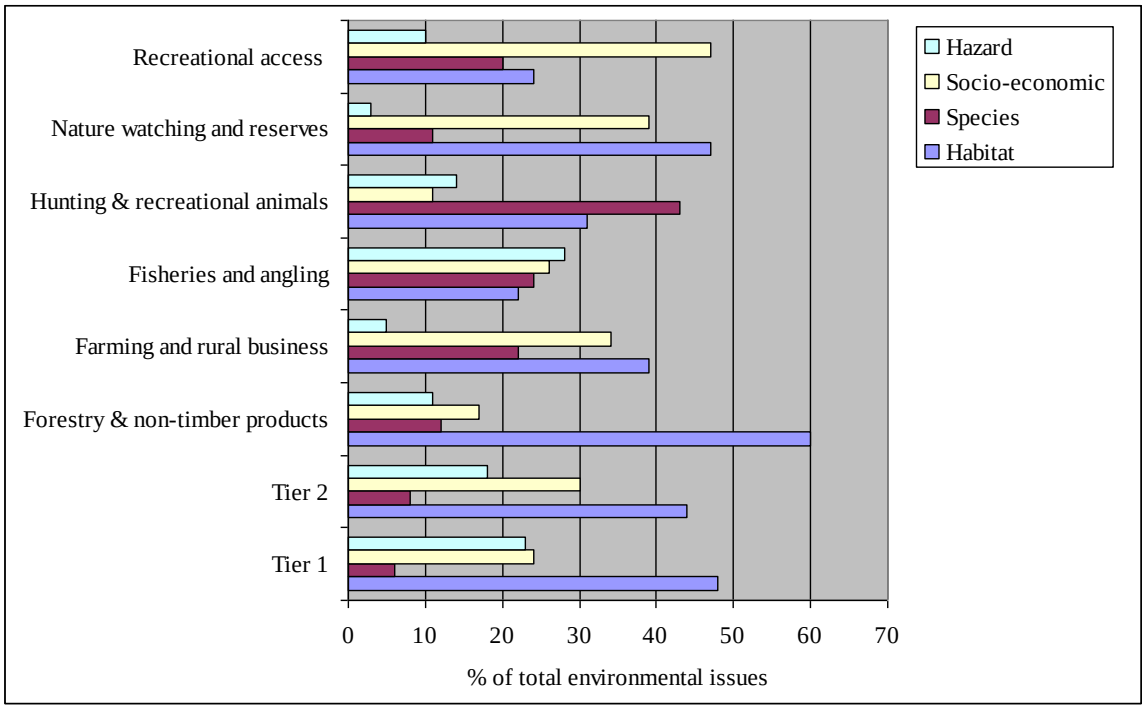


Figure 2. The relative proportion of issues identified in environmental decision making in each stakeholder category and tier of local government

The environmental issues listed by interviewees in the WP3 survey were identified as important issues in decision making. However, no attempt was made to quantify the number or complexities of decisions made per issue identified. The information flow models (figures 4-11) reflect the relative reporting of issues within different categories with a caveat regarding the limit of interpretation.

### 2.2. Information sources

All stakeholder categories and tiers of local government replied upon a wide variety of information sources to inform environmental issues identified (figure 3) which is discussed in detail in section 3.3 (Information flow models). The general differences between stakeholder categories and tiers of local government are listed below:

- “Farming and rural business” and “Fisheries and angling” use government agencies more than any other stakeholder category or tier of local government.
- “Nature watching and reserves” and “Forestry & non-timber products” rely upon their own records compared with other stakeholders.
- Local knowledge was used relatively little as an information source overall. Hunters did not use external local knowledge as an information source at all, preferring to use private consultants, government and their own local records.
- NGOs were used very little as an information source in forestry, but this may be explained by the fact that the large majority of forestry stakeholders were public companies owned and managed by government. For example, only one company in the forestry category was listed as an NGO (Hungary).
- Tier 1 relies on local knowledge more than Tier 2.

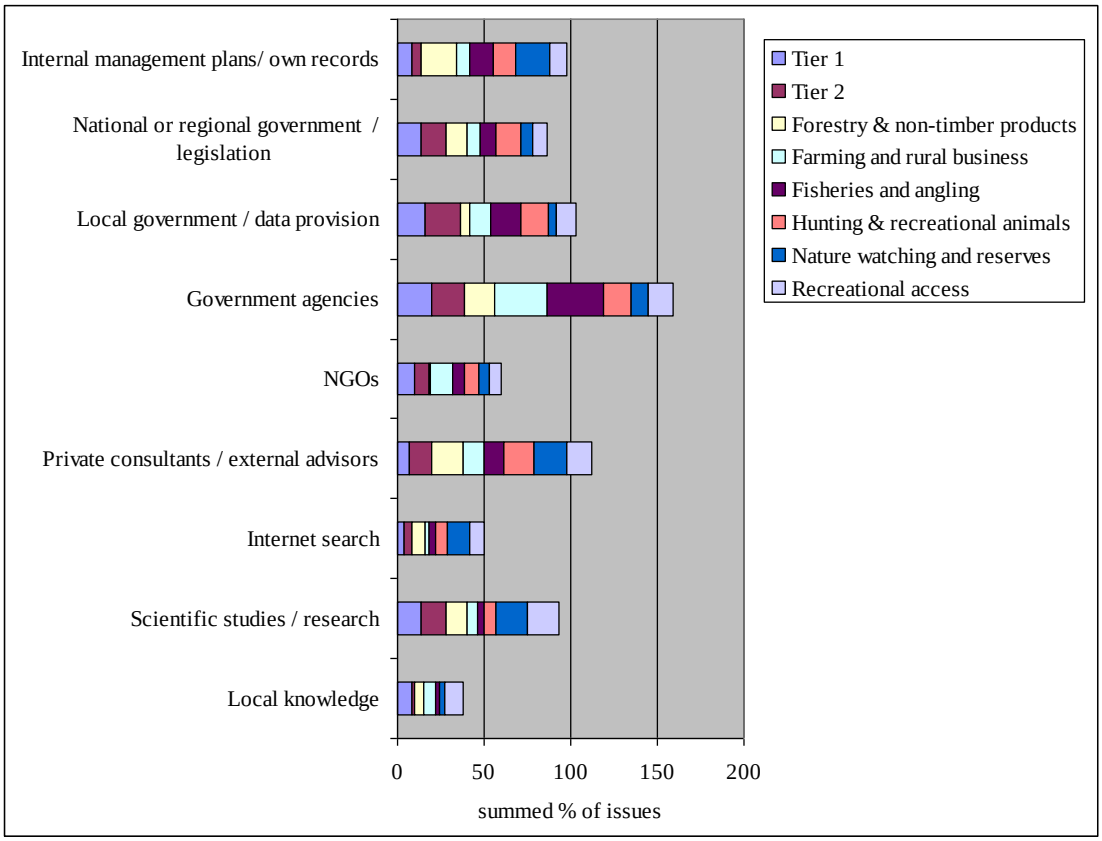


Figure 3. The relative frequency of use of categories of information sources that are used for environmental decision-making in each stakeholder category and tier of local government

## 2.3. Information flow models

The information flow models (figures 4-11) shows the direct link between the exchange of information and the decision making process. The model enables a detailed analysis of data exchange between local, regional and central information sources and emphasizes the importance of understanding and quantifying these relationships.

The models illustrate the complexity of information exchange and participation in local decision making. Most decision variables require information held at all levels; local, regional and central and the majority of decisions use a number of different information sources. The differences between stakeholder categories may reflect the nature of their activities and the complexity and number of decisions taken in these categories. The models incorporate eight case study areas so they are not intended to be representative of all environmental decisions made within these stakeholder groups. Therefore care should be taken in drawing general conclusions.

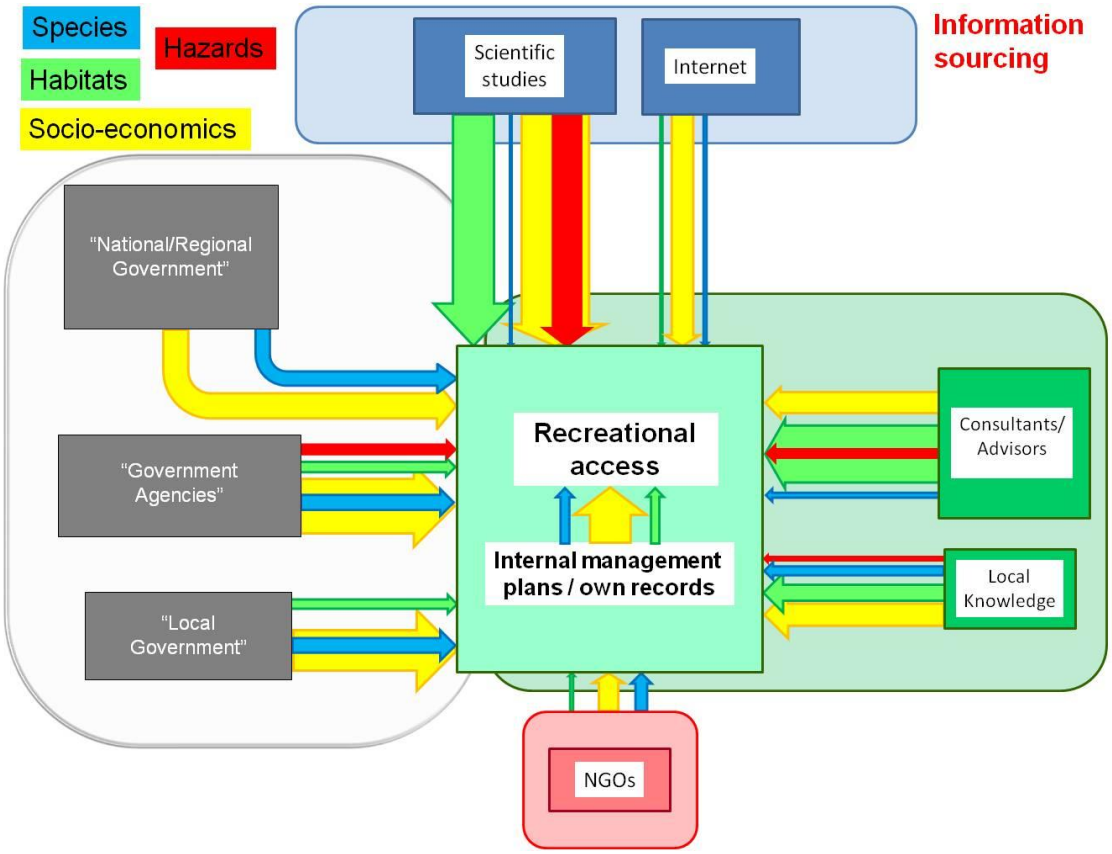


Figure 4. Information sources used by "Recreational access" stakeholders for environmental decision making.

Recreational access stakeholders sourced information from all the categories of suppliers, with socio-economic considerations (46% of 61 issues listed) the largest group of decision type for these stakeholders. This information for socio-economic decisions was sourced from all the groups of information providers, with the highest proportion from scientific studies (16%), followed by government agencies (14%). Information for habitat decisions was sourced from consultants/advisors (27%), as well as from scientific studies (23%), while all information sources provided some data on decisions to do with species. Information on hazards was sourced chiefly from scientific studies (44%) but also from government agencies and consultants/advisors (22% each).

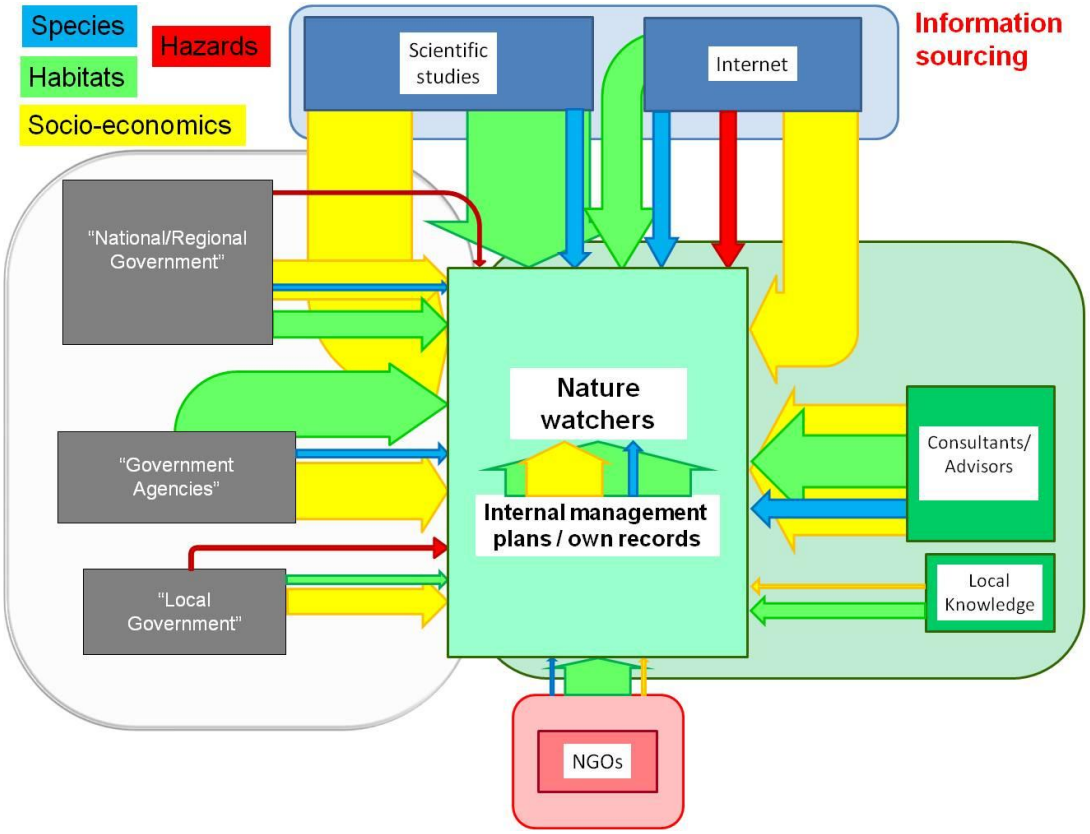


Figure 5. Information sources used by "Nature watching and reserves" stakeholders for environmental decision making.

The environmental issues identified by nature watcher stakeholders were chiefly related to habitat (42 of 93 – 45%) or socio-economics (40%). All information sources contributed information to these decisions but internal management plans/own records, consultants/advisors and scientific studies were most often referred to (20, 19 and 18% of the time respectively), with consultants/advisors slightly more important than scientific studies in the case of socio-economics (24% vs. 19%) but internal management plans/own records more important (28%) in the case of habitat decision making. This group of stakeholders was the group that used the internet the most in decision making, with 13% of information sourced this way overall. Information for decision making on issues to do with species come from a variety of sources, with information on hazards provided either by the internet (60%) or government sources (40%).

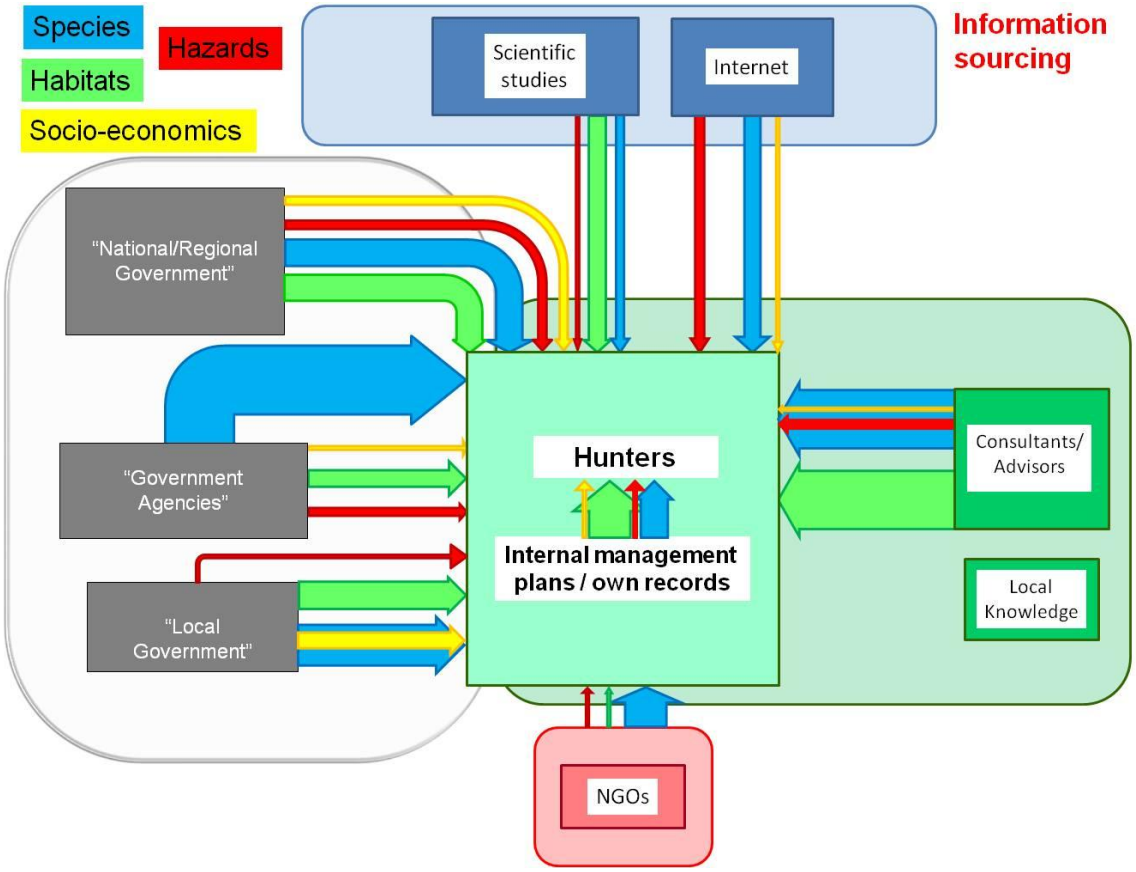


Figure 6. Information sources used by "Hunting and recreational animals" stakeholders for environmental decision making.

Hunters reported proportionally the most issues of any of the stakeholders (or in fact local government) involving species (22 of 64 or 34%), with a similar percentage of habitat related decisions. Although all information sources provided some information on most of the types of decision making, the information source providing the highest proportion of data for species decision making was government agencies (19%), followed by consultants/advisors (17%). Consultants/advisors provided the most information to hunters for habitat related decision making (23%) and it was remarkable that only 19% of decisions overall by hunters involved socio-economics, with information provided by a variety of sources. In the case of hunters, the "local knowledge" information source was not used, subsumed by hunter's internal management plans and own records, in which species data accounted for 5% of the total data provision, compared to 3% for foresters and 1-2% for other stakeholders.

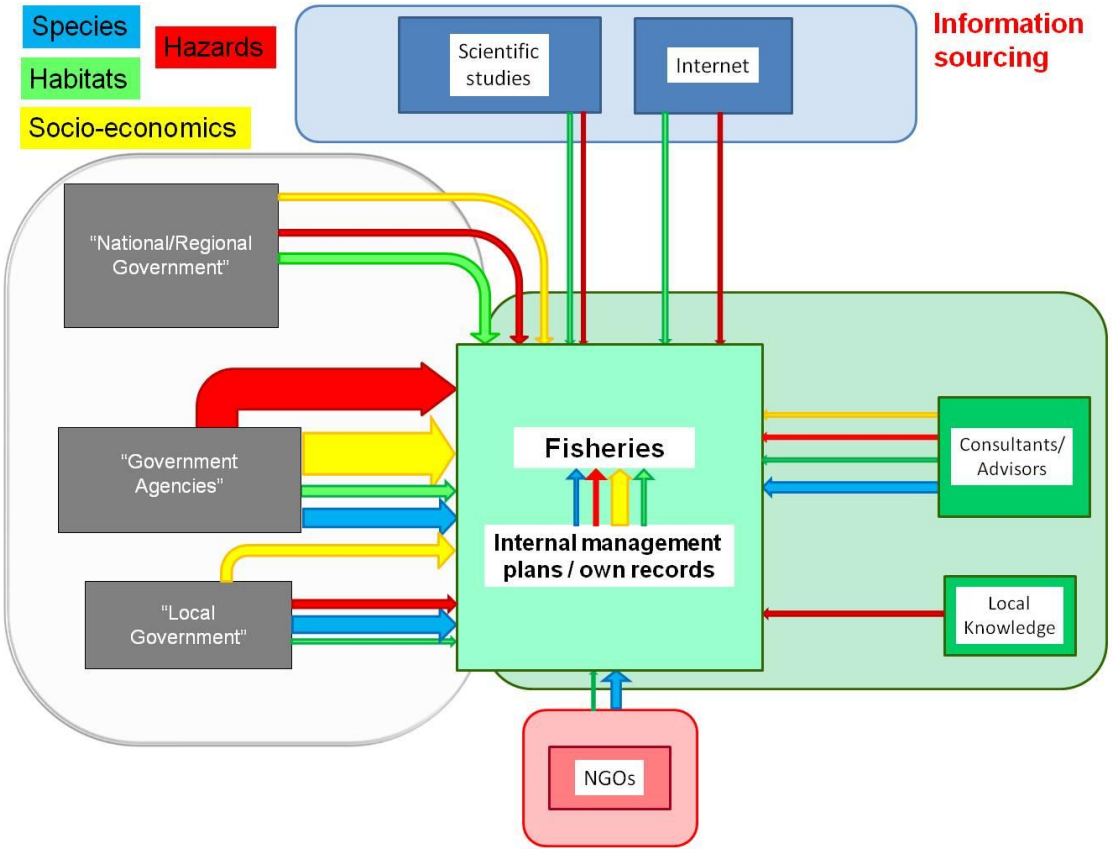


Figure 7. Information sources used by "Fisheries and angling" stakeholders for environmental decision making.

The issues that were identified by fisheries stakeholders were fairly evenly divided between the four types, with a slightly higher number involving hazards (11 of 38 or 29%), this was the stakeholder group with the largest proportion of issues involving hazards. This group sourced the majority of their information for all decisions on government sources, particularly government agencies (33% of the overall information sourcing, 38% of those involving hazards). Fisheries were also the stakeholder group that reported the lowest number of decisions overall, 38 compared to the stakeholder group with the next lowest number of decisions, those interested in recreational access with 61 in total. They also reported the lowest proportional use of consultants/advisors of all the stakeholder groups, only using them for 11% of information sourcing overall.

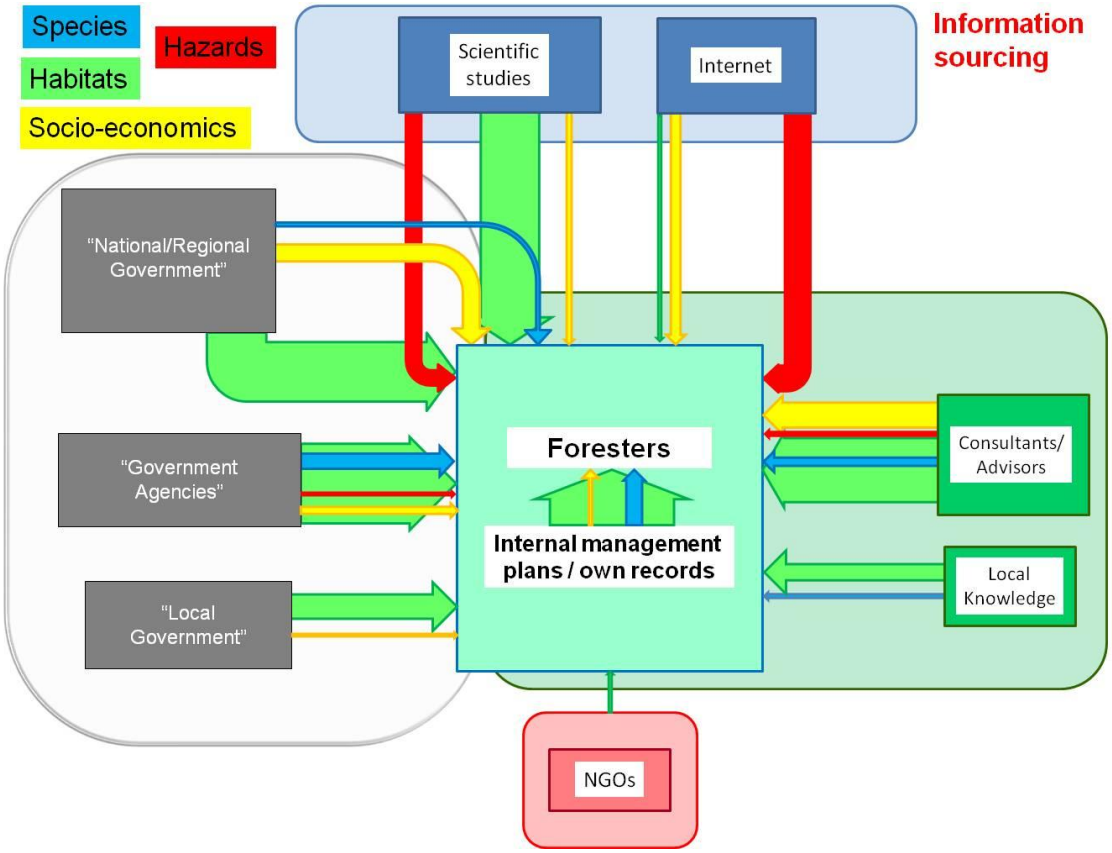


Figure 8. Information sources used by "Forestry and non-timber products" stakeholders for environmental decision making.

Most of the environmental issues identified by foresters involved habitats, 41 of 71 issues or 58%. For these they used their own internal management plans and records as an information source in just over a quarter of cases (26%). They consulted either consultants/advisors or a government agency each in 16% of cases, followed by national /regional government or scientific studies with 12% of cases each. The majority of information for decisions by forestry stakeholders involving hazards was sourced from the internet (44%) or scientific studies (33%).

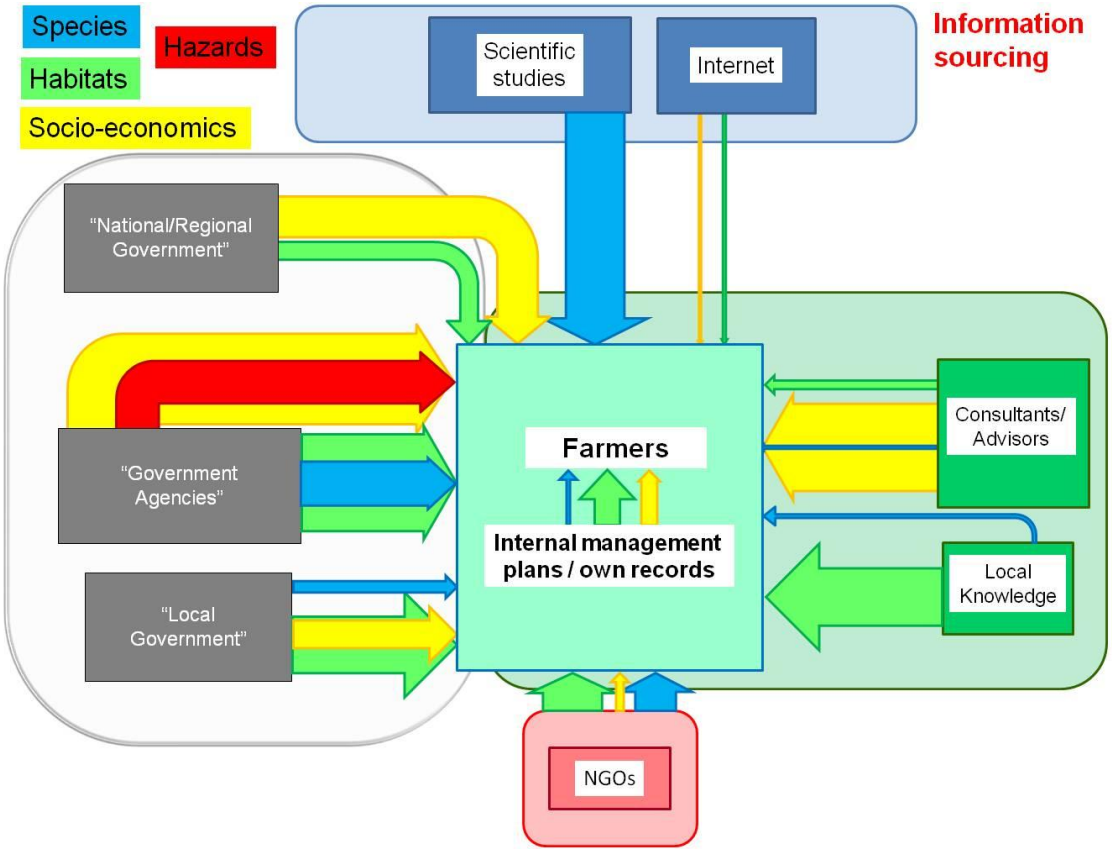


Figure 9. Information sources used by "Farming and rural business" stakeholders for environmental decision making.

The largest category of environmental issues identified by farmers was in the socio-economic category (31 of 79 listed – 39%). This was followed closely by issues involving habitats (29 or 37%). The largest single source of information was government agencies (29 of 97 decision/source combinations or 30% of these information sourcing episodes), with NGOs, consultants/advisors and local government all relatively equal in their information provision (13,12 and 12%, respectively). Government agencies tended to provide information on habitats (26% on these decisions) and socio-economic issues (27% of them) – though they were the only reported source of information on decision making involving hazards. Consultants/advisors were used primarily for socio-economic data (27% of this information sourcing), local government more for habitat information (16%), with NGOs used for habitat (16%) and species decisions (24%).

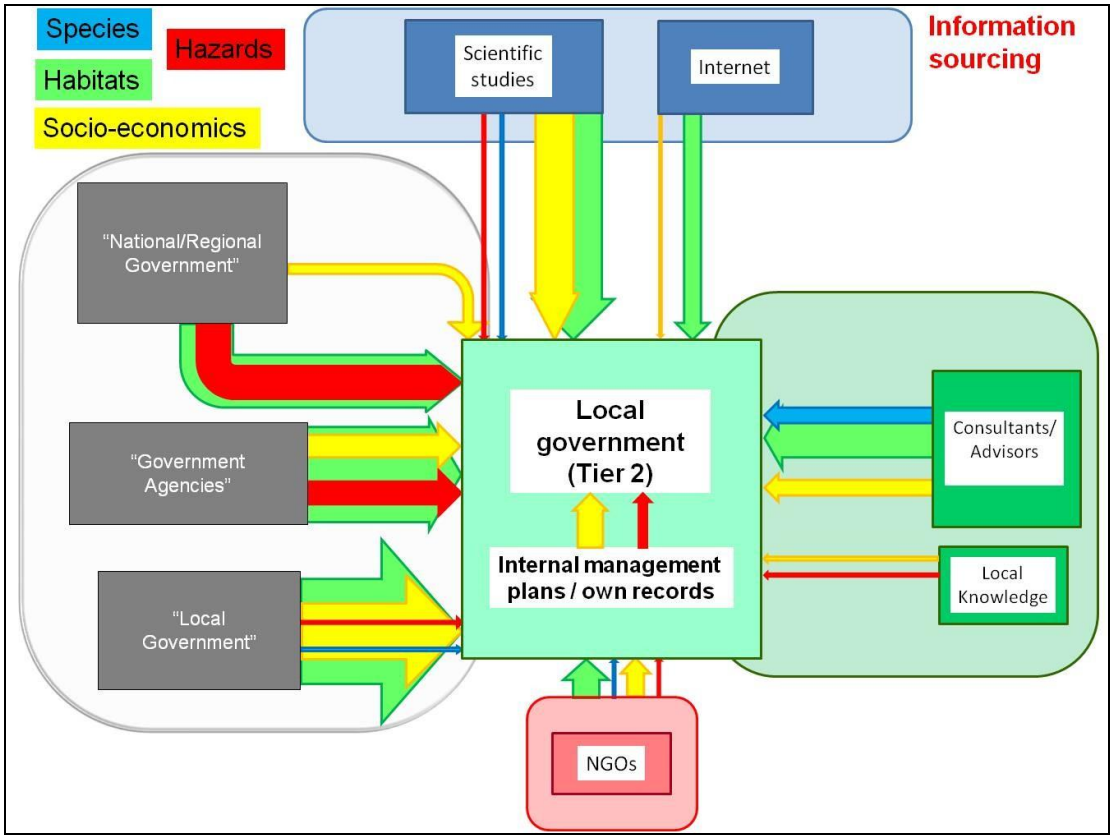

Figure 10. Information sources used by Tier 2 of local government for environmental decision making.

The majority of the environmental issues identified by Tier 2 of local government involved habitats (37 or 71 or 52%). For these decisions, a quarter of the information sourcing was done from government agencies, with local government and national/regional government providing 15% each, with 10% coming from scientific studies. Decisions involving hazards were the next most common for this level of government, 24% of issues identified. Just over a fifth of the information sourcing for these came from scientific studies, with government sources providing 18% at each level examined, a total of 54% of the information for decisions relating to hazards coming from a government level or agency. Just over a fifth of decisions involved socio-economics, with the information for these sourced from either scientific studies (19%) local government (16%) or government agencies and NGOs (12%) each. Only 2 of 71 issues (3%) identified by this level of government were considered to involve species, with no real pattern in where the information was sourced for these decisions.

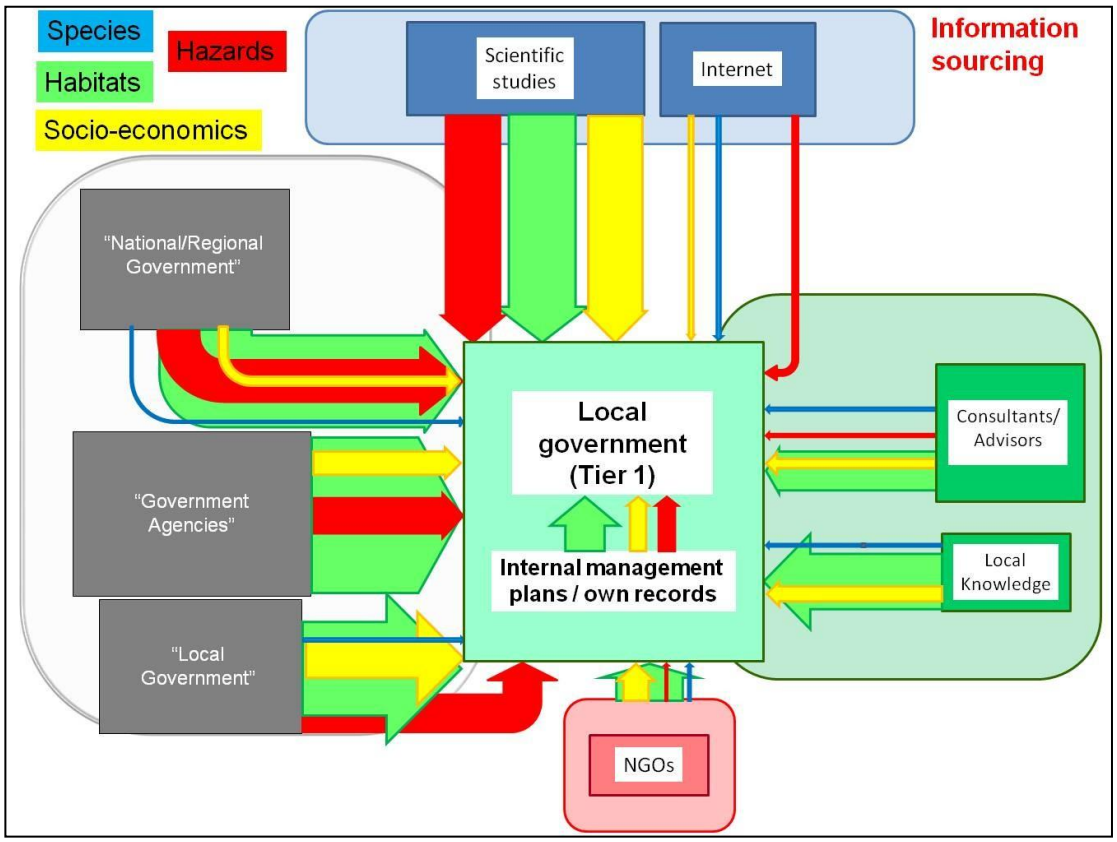


Figure 11. Information sources used by Tier 1 of local government for environmental decision making.

Tier 1 of local government reported fewer environmental issues than Tier 2 (56 versus 71). Of the 56, 46% (26) involved habitats, with a quarter related to socio-economic issues and nearly a fifth involving hazards. The information for habitat decision making was sourced chiefly from either local government (24%) or government agencies (22%), with most other sources providing some information for these decisions. A quarter of the issues identified by this level of government involved socio-economics, with local government providing 21% of the information for this decision making, followed by scientific studies (17%). Information sourcing for hazard related decisions was dominated by government sources, with a third of this overall coming from national/regional government and another third coming from a combination of government agencies (27%) and local government (7%). Again species did not figure in many of the decisions made at this level of government (9%) with most of the information for these decisions coming from consultants/advisors (50%). This lowest tier of government used local knowledge for 8% of decisions, compared with only 2% for decisions made by the tier above.

## 3. Summary and Conclusion

The conceptual models of information flow were designed to illustrate the flow of environmental information between local and central governments and local stakeholders in the decision making process. Decision making within the environmental sector is a highly complex process that relies on complex patterns of data exchange between stakeholders and local, regional and central levels of government. Understanding and quantifying these relationships is key to designing an effective decision support system to enable informed decisions.

### Environmental decisions

The largest number of environmental issues overall involved habitat issues, on average 36% of issues identified by stakeholder groups and 49% of issues identified by local government. Although information was supplied for these decisions from all sources, for local governments these tended to be skewed towards government sources. Foresters and nature watcher stakeholders both made use of their own internal management plans or records for these decisions (26% and 28%, respectively), but also relied on government agencies, scientific studies and consultants for information for these decisions.

Socio-economic issues were more important for the stakeholder groups (32% of issues) compared to the local government levels (23%). In particular nature watchers, farmers and recreational access stakeholder groups identified relatively more issues (an average of 42%). They used a variety of information sources for these decisions with particularly consultants (24%), scientific studies (19%) and the internet (14%) important for nature watchers, while farmers relied more on government sources (55% in total) instead of scientific studies and the internet, with consultants still quite important (27%). Recreational access stakeholders used all of the information sources for socio-economic decisions fairly evenly, as did the two levels of government.

Decisions involving species were more important overall for stakeholder groups (average of 19% versus 6% for local government) and figured highly for hunters and fisheries stakeholders (average of 29% of decisions). These two stakeholder groups used a variety of information sources to make these decisions, consultants (17% for hunters and 18% for fisheries) and government agencies (19% for hunters, fisheries 27%) figuring highly. Interestingly farmers were the group that made the most use of scientific surveys for these types of decisions (29%).

Hazard issues were relatively more important for the local government levels than for the stakeholder groups, with an average of 22% of issues by local government involving hazards, whilst the average was 13% for stakeholders. Fisheries stakeholders were the outlier amongst the stakeholders, with 29% of their issues involving hazards. For local government, fisheries and farmers, the government figured highly as an information source for hazards (average of 71% of information sourcing), particularly government agencies for fisheries and farmers (33% on average).

**Information sources**

Government figured highly as an information source for all decisions, with stakeholders using them for an average of 41% of information sourcing, and local government for an average of 51%. Amongst the three types of government information source, government agencies were the most consulted, with an average of 20% of information sourcing by stakeholders and 19% by local government. Stakeholders and local government both used scientific studies and the internet for roughly 18% of their information sourcing on average, with stakeholders relying more on internet searches,7% versus 4% for local government, while local government relied more on scientific surveys, 14% versus 11%. Local knowledge and NGOs did not figure highly as sources of information, with only 5% and 8% of stakeholder and local government information sourcing on average. Consultants/advisors were more important for stakeholder groups, with 15% of information sourcing provided by them versus 10% at the local government level. Nature watchers, hunters and foresters were noticeable in the relatively high use of consultants 19, 18 and 18% of information sourcing respectively. Interestingly for TESS, stakeholder groups relied nearly as much on their own records on average (14%) as they did on consultants and it was especially foresters (20%) and nature watchers (20%) who did this, as well as hunters (13%) and fisheries (13%) stakeholders.

## 4. References

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